Association for Information Systems
AIS Electronic Library (AISeL)

AMCIS 1996 Proceedings

Americas Conference on Information Systems (AMCIS)

8-16-1996

The Role of Real Options in Valuing Information Technology Projects

Jerry Flatto
North Carolina A&T State University, jflatto@sprynet.com

The Role of Real Options in Valuing Information Technology Projects

Dr. Jerry Flatto
North Carolina A&T State University
JFlatto@sprynet.com

Introduction

One concern associated with information technology is the inability to properly measure the costs and benefits associated with any specific project. At present, many of the costs can be estimated using a number of established techniques that yield a dollar value. However, many of the benefits are intangible and there are few techniques available to put a dollar value on the intangible benefits.

Therefore, the decision maker has to balance tangible costs with both tangible and intangible benefits. In many cases, the value of these intangible benefits are not included in the analysis of a project. This tends to result in an underestimate of the benefits associated with a project. Real options, a relatively new technique from the finance area, may provide the ability to measure some of the benefits that are presently treated qualitatively.

The Measurement Problem

Information technology is being used for many applications and purposes in organizations. Information technology's importance stems from its potential to affect the organization's value chain and influence the "bottom line".

Spending on information technology has increased. The share of information technology in the service sector's stock of capital equipment rose from 6.4% to almost 20% over the past twenty-five years. The number of personal computers went from 3 million to 23 million as their sales climbed from $1.9 billion to $40.8 billion. Mainframes' sales went from $16.5 billion to $35.5 billion. The service sector accounts for 82% of the installed information technology base. Each worker in the service sector is now supported by an average of $9,000 of computing power. Overall corporate spending on technology is expected to rise 10% this year. Information technology is now the largest item in the capital spending budget of corporate America - almost a third of all expenditures.

However, increased spending does not automatically equate to increased performance in the organization. One of the major concerns of top executives is the proper application of information technology in their organizations. They want to ensure that they are getting value for their money spent.

Unfortunately, recent studies have shown little or no productivity gains from the investments in information technology. These results are symptomatic of the computer productivity paradox. In 1993, Computerworld magazine and Andersen Consulting found that fewer than half of the 203 senior corporate officers surveyed thought they were getting good value from their information technology spending.

The most likely reason for this productivity paradox is the inability to properly measure the benefits associated with information technology. The first information systems developed forty years ago provided their benefit through a direct reduction in costs Now many information technology projects do not only reduce costs but are also designed to produce other benefits. The benefits provided may include more accurate information allowing management to make better decisions; increased customer satisfaction; and changes in the organization's infrastructure which can yield benefits totally unexpected in the original analysis process.

The measurement problem is also more severe when looking at benefits as compared to costs. While errors in measurement affect both the costs and benefits associated with an information technology project, measurement errors tend to be biased towards underestimating benefits because of their intangible nature.

The development of quantitative methods to measure the benefits of information technology are especially important since the management review process tends to be biased against qualitative benefits. Management typically assigns greater weight in the decision making process to quantitative benefits.

Real Options

By 1994, 95% of the companies indicated that discounted cash flow analysis was either very important or somewhat important in getting a project accepted. The three most common techniques used are internal rate of return, net present value, and payback. Of these three techniques, net present value provides the "best" answer.

However, net present value analysis has some associated limitations that can result in the value of a project being underestimated. A traditional net present value analysis makes implicit assumptions concerning an expected scenario of cash flows. It presumes management's passive commitment to a certain "operating strategy" (e.g., to initiate the project immediately, and operate it continuously at a set scale until the end of its pre-specified expected useful life). It also ignores the synergistic effects that an investment project can create. Net present value analysis usually underestimates investment opportunities because it ignores management's flexibility to alter decisions as new information becomes available. Because of these limitations, 76% of firms accept projects that fail quantitative analysis.

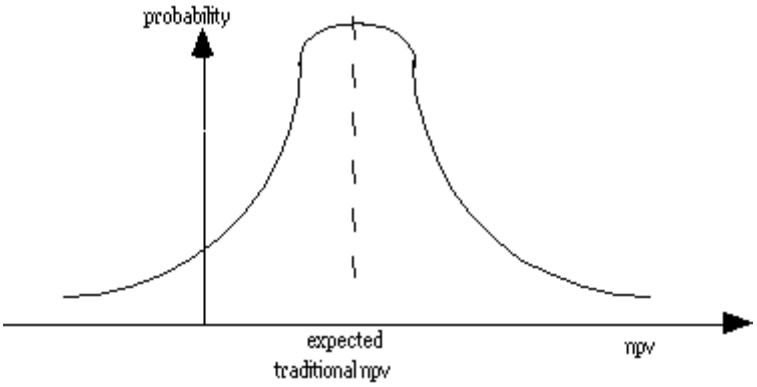

Figure 1: Project under traditional net present value

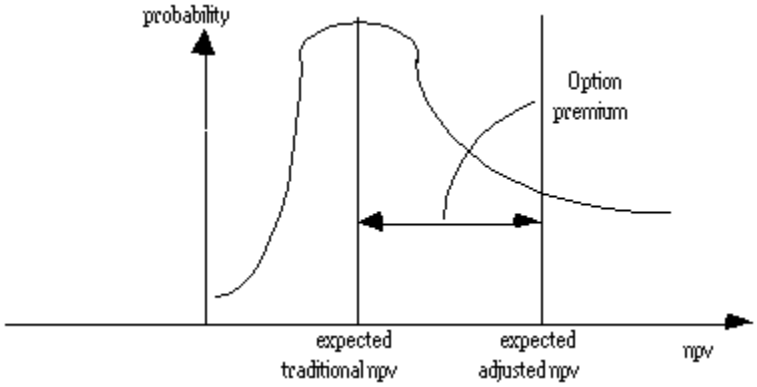

Figure 2: Project under adjusted present value, including the real options

One approach to including the value of management's flexibility in the analysis process is by the use of option pricing theory and real options. Options allow an investor to determine a dollar value for an event

that is to occur in the future. Historically, options have been used to value future possibilities associated with financial assets such as stocks.

The concept of real options is based upon the fact that management does have the flexibility to alter decisions as further information becomes available. If future conditions are favorable, a project may be expanded to take advantage of these conditions. On the other hand, if the future is unfavorable, a project may be curtailed or even canceled as the conditions warrant. A traditional net present value analysis does not take these factors into account. The difference between a traditional and dynamic valuation approach can be seen by examining the probability distributions of the expected value of a project.

A traditional net present value analysis generates a range of probable expected values with the most likely value in the center of a symmetric normal probability distribution as shown in Figure 1. An adjusted present value analysis, including the value of the real options, incorporates into the analysis process management's flexibility to improve a project's upside potential while limiting the impact of the project's downside losses. This results in a project with a higher expected value and causes the distribution to be skewed to the right as shown in Figure 2. The difference between the expected values is the value of the real options and is called the option premium.

Previous work in real options has generated a taxonomy that has broken down real options into six categories based upon the type of flexibility provided. The six categories are: the option to defer; the option for staged investments; the option to change the existing scale; the option to abandon; the option to switch use; and the option to grow. It is also possible for a project to have more than one category of real options be applicable that leads to multiple interacting real options.

Integrated Model

Before real options can be used to help value the flexibility provided by an information technology project, they must be integrated into a cost benefit model. This section shows the top level of a three level model that identifies where real options fit in to the analysis process.

The costs associated with an information technology project fall into a number of categories. Four cost categories include: procurement costs associated with the equipment; start-up costs; project related costs; and ongoing costs.

The benefits can also be placed into a number of categories. Some of the benefits provided are concrete such as a reduction in processing errors or reduction in the amount of labor to perform tasks. Other benefits are abstract such as "better data for decision making".

Figure 3 shows a model that ties the costs and benefits of an information technology project together. One of the benefits is called "flexibility". Real options are a technique that can be used to value this flexibility. Thus, real options fit directly into the existing analysis models.

The flexibility associated with information technology can be considered from two aspects. First of all, the flexibility can be associated with the information technology itself. The flexibility to grow can indicate the hardware and software associated with the project can be expanded if there is a need. For example, additional memory and hard disk space can be added to the hardware if the future conditions warrant. Alternately, the flexibility to grow can mean that the organization can grow because of the information technology project. For example, developing an information technology project that can mine new information from previously collected data allows the organization the flexibility to use that information to grow in ways that were not possible without the information technology project.

Further Research

The development of an integrated model is only the first stage in the application of real options to valuing information technology. An investigation of the existing and potential use of real options in the insurance industry provided some insights on areas where further research is needed.

The investigation found that very few companies are aware of the concept of real options and even fewer have any formal process to include the value of the real options in their existing analysis process.

In order to raise the awareness of real options and their value in the analysis process, more "marketing" must be done, regardless of the types of projects or industry. Without this effort, applications of real options will likely be limited to academic interest and specialized applications in certain companies.

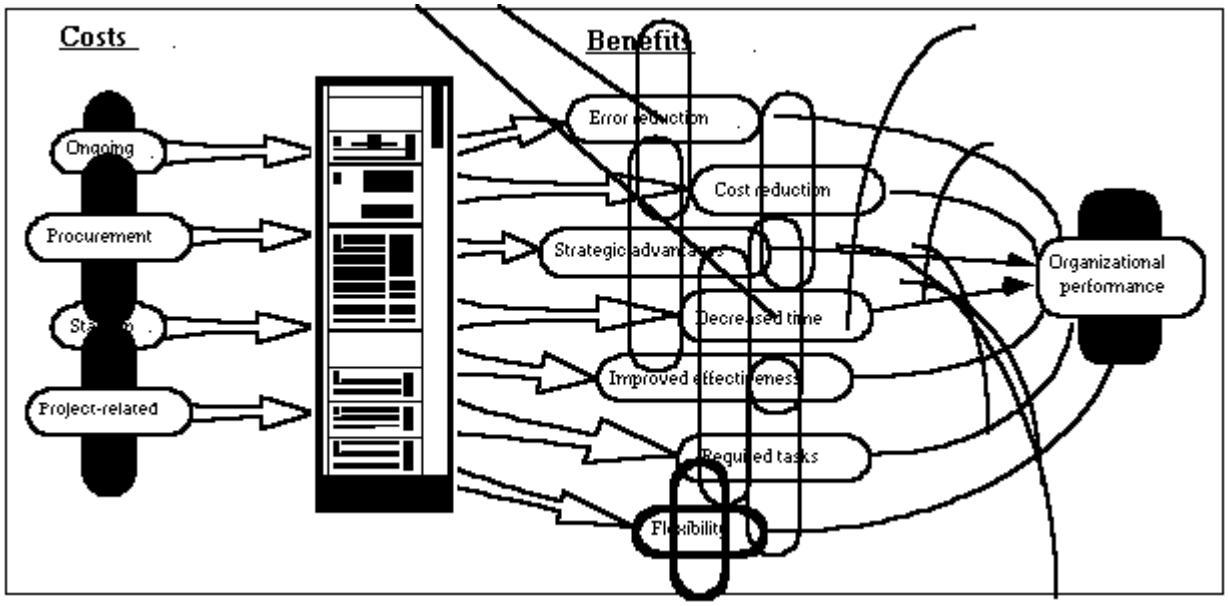

Figure 3: Costs and benefits of an information technology project

It is recommended that further research in the area of real options be focused on demonstrating to industry how real options can fit into their evaluation models and improve them. Rather than developing mathematical models, effort should be allocated to improving existing qualitative models. There are a number of existing models that break down both the steps involved with building an information system and performing cost benefit analysis of the systems.

The research that needs to be done is integrating real options into these existing models. At each step in the model, the appropriate types of real options should be added to the model. The expanded model should detail not only the types of real options applicable, but more importantly how these real options can reduce the risks associated with the projects' development.

Conclusion

More effort and education is needed to transfer real options from the academic arena to industry use. This effort is vital since existing analysis tools such as net present value underestimate the value of projects. As Stephen Ross states: "For most investments, the usefulness of the NPV rule is severely limited. … If modern finance is to have a practical and salutary impact on investment-decision making, it is now obligated to treat all major investment decisions as option pricing problems."